US006846399B2

(12) **United States Patent**
Shepodd et al.

(10) **Patent No.: US 6,846,399 B2**
(45) **Date of Patent: Jan. 25, 2005**

(54) **CASTABLE THREE-DIMENSIONAL STATIONARY PHASE FOR ELECTRIC FIELD-DRIVEN APPLICATIONS**

(75) Inventors: **Timothy J. Shepodd**, Livermore, CA (US); **Leroy Whinnery, Jr.**, Danville, CA (US); **William R. Even, Jr.**, Livermore, CA (US)

(73) Assignee: **Sandia National Laboratories**, Livermore, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 568 days.

(21) Appl. No.: **09/796,762**

(22) Filed: **Feb. 28, 2001**

(65) **Prior Publication Data**

US 2001/0008212 A1 Jul. 19, 2001

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/310,465, filed on May 12, 1999, now abandoned.

(51) **Int. Cl.**[7] **G01N 27/447**

(52) **U.S. Cl.** **204/470**; 204/451; 204/455; 204/456; 204/469

(58) **Field of Search** 204/450, 451, 204/455, 456, 465, 469, 470, 600, 601, 605, 606, 615; 521/64, 146, 149

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,522,953	A *	6/1985	Barby et al.	521/64
5,021,462	A	6/1991	Elmes	521/63
5,135,627	A	8/1992	Soane	204/182.8
5,334,310	A	8/1994	Frechet	210/198.2
5,431,807	A	7/1995	Frechet	210/198.2
5,453,185	A	9/1995	Frechet	210/198.2
5,569,364	A *	10/1996	Hooper et al.	204/455
5,728,457	A	3/1998	Frechet	428/310.5
6,117,326	A *	9/2000	Schure et al.	210/635

OTHER PUBLICATIONS

Peters et al., "Molded Rigid Polymer Monoliths as Separation Media for Capillary Electrochromatography", *Analytical Chemistry*, 69, 3646–3649, 1997.

* cited by examiner

Primary Examiner—Nam Nguyen
Assistant Examiner—Brian L. Mutschler
(74) *Attorney, Agent, or Firm*—Donald A. Nissen

(57) **ABSTRACT**

A polymer material useful as the porous dielectric medium for microfluidic devices generally and electrokinetic pumps in particular. The polymer material is produced from an inverse (water-in-oil) emulsion that creates a 3-dimensional network characterized by small pores and high internal volume, characteristics that are particularly desirable for the dielectric medium for electrokinetic pumps. Further, the material can be cast-to-shape inside a microchannel. The use of bifunctional monomers provides for charge density within the polymer structure sufficient to support electroosmotic flow. The 3-dimensional polymeric material can also be covalently bound to the channel walls thereby making it suitable for high-pressure applications.

12 Claims, 1 Drawing Sheet